MATH HANDBOOK TRANSPARENCY MASTER 1

Scientific Notation

Use with Appendix B, Scientific Notation

Packet taken from:
http://www1.nsd131.org/classpages/awilkens/Shared%20Documents/Scientific%20Notation%20Worksheets.pdf

Scientists need to express small measurements, such as the mass of the proton at the center of a hydrogen atom (0.000 000 000 000 000 000 000 000 001 673 kg), and large measurements, such as the temperature at the center of the Sun (15 000 000 K). To do this conveniently, they express the numerical values of small and large measurements in scientific notation, which has two parts.

A number in which only one digit is placed to the left of the decimal → $N \times 10^n$ ← An exponent of 10 by which the number is multiplied

Thus, the temperature of the Sun, 15 million kelvins, is written as 1.5×10^7 K in scientific notation.

Positive Exponents Express 1234.56 in scientific notation.

Each time the decimal place is moved one place to the left, the exponent is increased by one.

$$1234.56$$
$$1234.56 \times 10^0 = 123.456 \times 10^1$$
$$123.456 \times 10^1 = 12.3456 \times 10^2$$
$$12.3456 \times 10^2 = 1.234\ 56 \times 10^3$$
$$1.234\ 56 \times 10^3$$

Negative Exponents Express 0.006 57 in scientific notation.

Each time the decimal place is moved one place to the right, the exponent is decreased by one.

$$0.006\ 57$$
$$0.006\ 57 \times 10^0 = 0.0657 \times 10^{-1}$$
$$0.0657 \times 10^{-1} = 0.657 \times 10^{-2}$$
$$0.657 \times 10^{-2} = 6.57 \times 10^{-3}$$
$$6.57 \times 10^{-3}$$

MATH HANDBOOK TRANSPARENCY WORKSHEET 1

Scientific Notation

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1. Express each of the following numbers in scientific notation.

a. 230

b. 5601

c. 14 100 000

d. 56 million

e. 2/10

f. 0.450 13

g. 0.089

h. 0.000 26

i. 0.000 000 698

j. 12 thousandth

2. Express each of the following measurements in scientific notation.

a. speed of light in a vacuum, 299 792 458 m/s

b. number of seconds in a day, 86 400 s

c. mean radius of Earth, 6378 km

d. density of oxygen gas at 0°C and pressure of 101 kPa, 0.001 42 g/mL

e. radius of an argon atom, 0.000 000 000 098 m

SCIENTIFIC NOTATION

Name ____________________

Scientists very often deal with very small and very large numbers, which can lead to a lot of confusion when counting zeros! We have learned to express these numbers as powers of 10.

Scientific notation takes the form of $M \times 10^n$ where $1 \leq M < 10$ and "n" represents the number of decimal places to be moved. Positive n indicates the standard form is a large number. Negative n indicates a number between zero and one.

Example 1: Convert 1,500,000 to scientific notation.
We move the decimal point so that there is only one digit to its left, a total of 6 places.

1,500,000 = 1.5×10^6

Example 2: Convert 0.000025 to scientific notation.
For this, we move the decimal point 5 places to the right.

0.000025 = 2.5×10^{-5}

(Note that when a number starts out less than one, the exponent is always negative.)

Convert the following to scientific notation.

1. 0.005 = ____________________
2. 5,050 = ____________________
3. 0.0008 = ____________________
4. 1,000 = ____________________
5. 1,000,000 = ____________________
6. 0.25 = ____________________
7. 0.025 = ____________________
8. 0.0025 = ____________________
9. 500 = ____________________
10. 5,000 = ____________________

Convert the following to standard notation.

1. 1.5×10^3 = ____________________
2. 1.5×10^{-3} = ____________________
3. 3.75×10^{-2} = ____________________
4. 3.75×10^2 = ____________________
5. 2.2×10^5 = ____________________
6. 3.35×10^{-1} = ____________________
7. 1.2×10^{-4} = ____________________
8. 1×10^4 = ____________________
9. 1×10^{-1} = ____________________
10. 4×10^0 = ____________________

MATH HANDBOOK TRANSPARENCY MASTER 2

Operations with Scientific Notation

Use with Appendix B, Operations with Scientific Notation

Addition and Subtraction

Before numbers in scientific notation can be added or subtracted, the exponents must be equal.

Not equal — Equal

$$(3.4 \times 10^2) + (4.57 \times 10^3) = (0.34 \times 10^3) + (4.57 \times 10^3)$$

The decimal is moved to the left to increase the exponent.

$$= (0.34 + 4.57) \times 10^3$$

$$= 4.91 \times 10^3$$

Multiplication

When numbers in scientific notation are multiplied, only the number is multiplied. The exponents are added.

$$(2.00 \times 10^3)(4.00 \times 10^4) = (2.00)(4.00) \times 10^{3+4}$$

$$= 8.00 \times 10^7$$

Division

When numbers in scientific notation are divided, only the number is divided. The exponents are subtracted.

$$\frac{9.60 \times 10^7}{1.60 \times 10^4} = \frac{9.60}{1.60} \times 10^{7-4}$$

$$= 6.00 \times 10^3$$

Name ______________________ Date ____________ Class ____________

MATH HANDBOOK TRANSPARENCY WORKSHEET **2**

Operations with Scientific Notation

Use with Appendix B, Operations with Scientific Notation

1. Perform the following operations and express the answers in scientific notation.

a. $(1.2 \times 10^5) + (5.35 \times 10^6)$

b. $(6.91 \times 10^{-2}) + (2.4 \times 10^{-3})$

c. $(9.70 \times 10^6) + (8.3 \times 10^5)$

d. $(3.67 \times 10^2) - (1.6 \times 10^1)$

e. $(8.41 \times 10^{-5}) - (7.9 \times 10^{-6})$

f. $(1.33 \times 10^5) - (4.9 \times 10^4)$

2. Perform the following operations and express the answers in scientific notation.

a. $(4.3 \times 10^8) \times (2.0 \times 10^6)$

b. $(6.0 \times 10^3) \times (1.5 \times 10^{-2})$

c. $(1.5 \times 10^{-2}) \times (8.0 \times 10^{-1})$

d. $\dfrac{7.8 \times 10^3}{1.2 \times 10^4}$

e. $\dfrac{8.1 \times 10^{-2}}{9.0 \times 10^2}$

f. $\dfrac{6.48 \times 10^5}{(2.4 \times 10^4)(1.8 \times 10^{-2})}$

Name________________ Date__________ Class__________

MATH HANDBOOK TRANSPARENCY WORKSHEET 1

Scientific Notation

Use with Appendix B, Scientific Notation

1. Express each of the following numbers in scientific notation.
   a. 230
      $230 = 2.3 \times 10^2$
   b. 5601
      $5601 = 5.601 \times 10^3$
   c. 14 100 000
      $14\ 100\ 000 = 1.41 \times 10^7$
   d. 56 million
      56 million $= 56\ 000\ 000 = 5.6 \times 10^7$
   e. 2/10
      $2/10 = 2 \times 0.1 = 2 \times 10^{-1}$
   f. 0.450 13
      $0.450\ 13 = 4.5013 \times 10^{-1}$
   g. 0.089
      $0.089 = 8.9 \times 10^{-2}$
   h. 0.000 26
      $0.000\ 26 = 2.6 \times 10^{-4}$
   i. 0.000 000 698
      $0.000\ 000\ 698 = 6.98 \times 10^{-7}$
   j. 12 thousandth
      12 thousandth $= 12/1000 = 12 \times 0.001 = 12 \times 10^{-3} = 1.2 \times 10^{-2}$
2. Express each of the following measurements in scientific notation.
   a. speed of light in a vacuum, 299 792 458 m/s
      $299\ 792\ 458$ m/s $= 2.997\ 924\ 58 \times 10^8$ m/s
   b. number of seconds in a day, 86 400 s
      $86\ 400$ s $= 8.64 \times 10^4$ s
   c. mean radius of Earth, 6378 km
      6378 km $= 6.378 \times 10^3$ km
   d. density of oxygen gas at 0°C and pressure of 101 kPa, 0.001 42 g/mL
      $0.001\ 42$ g/mL $= 1.42 \times 10^{-3}$ g/mL
   e. radius of an argon atom, 0.000 000 000 098 m
      $0.000\ 000\ 000\ 098$ m $= 9.8 \times 10^{-11}$ m

Name________________ Date__________ Class__________

MATH HANDBOOK TRANSPARENCY WORKSHEET 2

Operations with Scientific Notation

Use with Appendix B, Operations with Scientific Notation

1. Perform the following operations and express the answers in scientific notation.
   a. $(1.2 \times 10^5) + (5.35 \times 10^6)$
      $(1.2 \times 10^5) + (5.35 \times 10^6) = (0.12 \times 10^6) + (5.35 \times 10^6) = (0.12 + 5.35) \times 10^6$
      $= 5.47 \times 10^6$
   b. $(6.91 \times 10^{-2}) + (2.4 \times 10^{-3})$
      $(6.91 \times 10^{-2}) + (2.4 \times 10^{-3}) = (6.91 \times 10^{-2}) + (0.24 \times 10^{-2})$
      $= (6.91 + 0.24) \times 10^{-2} = 7.15 \times 10^{-2}$
   c. $(9.70 \times 10^6) + (8.3 \times 10^5)$
      $(9.70 \times 10^6) + (8.3 \times 10^5) = (9.70 \times 10^6) + (0.83 \times 10^6) = (9.70 + 0.83) \times 10^6$
      $= 10.53 \times 10^6 = 1.053 \times 10^7$
   d. $(3.67 \times 10^2) - (1.6 \times 10^1)$
      $(3.67 \times 10^2) - (1.6 \times 10^1) = (3.67 \times 10^2) - (0.16 \times 10^2) = (3.67 - 0.16) \times 10^2$
      $= 3.51 \times 10^2$
   e. $(8.41 \times 10^{-6}) - (7.9 \times 10^{-7})$
      $(8.41 \times 10^{-6}) - (7.9 \times 10^{-7}) = (8.41 \times 10^{-6}) - (0.79 \times 10^{-6})$
      $= (8.41 - 0.79) \times 10^{-6} = 7.62 \times 10^{-6}$
   f. $(1.33 \times 10^5) - (4.9 \times 10^4)$
      $(1.33 \times 10^5) - (4.9 \times 10^4) = (1.33 \times 10^5) - (0.49 \times 10^5) = (1.33 - 0.49) \times 10^5$
      $= 0.84 \times 10^5 = 8.4 \times 10^4$
2. Perform the following operations and express the answers in scientific notation.
   a. $(4.3 \times 10^8) \times (2.0 \times 10^6)$
      $(4.3 \times 10^8) \times (2.0 \times 10^6) = (4.3)(2.0) \times 10^{8+6} = 8.6 \times 10^{14}$
   b. $(6.0 \times 10^3) \times (1.5 \times 10^{-2})$
      $(6.0 \times 10^3) \times (1.5 \times 10^{-2}) = (6.0)(1.5) \times 10^{3+(-2)} = 9.0 \times 10^1$
   c. $(1.5 \times 10^{-2}) \times (8.0 \times 10^{-1})$
      $(1.5 \times 10^{-2}) \times (8.0 \times 10^{-1}) = (1.5)(8.0) \times 10^{-2+(-1)} = 12.00 \times 10^{-3}$
      $= 1.2 \times 10^{-2}$
   d. $\frac{7.8 \times 10^3}{1.2 \times 10^4}$
      $7.8 \times 10^3/1.2 \times 10^4 = 7.8/1.2 \times 10^{3-4} = 6.5 \times 10^{-1}$
   e. $\frac{8.1 \times 10^{-2}}{9.0 \times 10^2}$
      $8.1 \times 10^{-2}/9.0 \times 10^2 = 8.1/9.0 \times 10^{-2-2} = 0.90 \times 10^{-4} = 9.0 \times 10^{-5}$
   f. $\frac{6.48 \times 10^5}{(2.4 \times 10^4)(1.8 \times 10^{-2})}$
      $6.48 \times 10^5/(2.4 \times 10^4)(1.8 \times 10^{-2}) = 6.48/(2.4)(1.8) \times 10^{5-4-(-2)} = 1.5 \times 10^3$

SCIENTIFIC NOTATION

Name ________________

Scientists very often deal with very small and very large numbers, which can lead to a lot of confusion when counting zeros! We have learned to express these numbers as powers of 10.

Scientific notation takes the form of $M \times 10^n$ where $1 \le M < 10$ and "n" represents the number of decimal places to be moved. Positive n indicates the standard form is a large number whereas negative n would indicate a number smaller than zero.

> **Example 1:** Convert 1,500,000 to scientific notation.
> We move the decimal point so that there is only one digit to its left, a total of 6 places.
> $1{,}500{,}000 = 1.5 \times 10^6$
>
> **Example 2:** Convert 0.000025 to scientific notation.
> For this, we move the decimal point 5 places to the right.
> $0.000025 = 2.5 \times 10^{-5}$
> (Note that when a number starts out less than one, the exponent is always negative.)

Convert the following to scientific notation.

1. 0.005 = 5×10^{-3}
2. 5,050 = 5.05×10^3
3. 0.0008 = 8×10^{-4}
4. 1,000 = 1×10^3
5. 1,000,000 = 1×10^6
6. 0.25 = 2.5×10^{-1}
7. 0.025 = 2.5×10^{-2}
8. 0.0025 = 2.5×10^{-3}
9. 500 = 5×10^2
10. 5,000 = 5×10^3

Convert the following to standard notation.

1. 1.5×10^3 = 1,500
2. 1.5×10^{-3} = 0.0015
3. 3.75×10^{-2} = 0.0375
4. 3.75×10^2 = 375
5. 2.2×10^5 = 220,000
6. 3.35×10^{-1} = 0.335
7. 1.2×10^{-4} = 0.00012
8. 1×10^4 = 10,000
9. 1×10^{-1} = 0.1
10. 4×10^0 = 4